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DEVELOPING A FEDERAL STRATEGY FOR ENVIRONMENTAL CONTROL IN CANADA

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Systems Research Group

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by

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TITLE OF PROJECT:	Federal Strategy for Environmental Quality Control
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CONTRACTING AGENCY:	Department of Energy, Mines and Resources
DURATION OF PROJECT:	One Year

1. Abstract of Study

The purpose of the study is to develop a "strategy" or conceptual framework to assist the Federal Government of Canada to evaluate new policies and programs to deal with the problems of pollution, urbanization and the quality of life. The emphasis of this study is on the development of policy-oriented recommendations through the application of systems analysis.

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2. BODY OF THE PROPOSAL

2.1 The Problem

2.1.1 Deterioration of the Environment

For eons, the environment of the Earth's surface and its atmosphere remained essentially stable. Mankind took the air, water and soil as he found it - and he left it basically unchanged.

Recent demographic, technological and economic changes have begun to disrupt significantly the environment of the Earth and the ecology of all its species. Population growth and urbanization have brought sprawling metropolises. The advance of science has spawned new technologies which produce subtle physical and chemical side effects. Economic growth has made a great waste producer of man and all the industries that serve him.

It is now impossible to escape the conclusion that the deterioration of our environment is real and that it poses dangers to all life on the planet.

2.1.2 Externalities - A Primary Cause of Pollution

Certain fundamental flaws in our market-oriented economic and social systems inhibit the automatic self-organization of adequate pollution prevention and abatement controls.

A pollution problem is likely to arise when potential polluters can contemplate the benefit derived from discharging a waste without simultaneously contemplating the costs borne by potential pollutees. The cost is then external to the polluter and fails to enter his cost-benefit calculus.

The goal is to "internalize" the externalities so that the potential polluter is forced to include the full cost of his actions in his cost-

2.1.3 "Public Goods" and Pollution Control

Externalities may exist also on the benefit side. The benefits from a program of pollution control are often unrealized by the executor of that program. In this case, the benefits cannot be taken into cost-benefit calculus. The amount of pollution control "produced" tends to be less, therefore, than if "producers" could realize part of the benefit which might be provided.

An extreme case of external benefits when the amount of benefit realized by any person does not diminish the benefits potentially realizable by others. This is the case of "public goods." The quality of the environment is, in many respects, a public good. The enjoyment of clean air, clean water and attractive surroundings in no way diminishes the benefits enjoyable by others.

Operationally, the task is to "internalize" the benefits of a superior environment within the same decision-making units that must incur the costs of "producing" that superior environment.

2.1.4 The Costs of Pollution Control

Pollution control is not free; it costs. If the social costs of pollution were to be successfully internalized, the production (or utilization) costs of many producers (or consumers) would be significantly affected.

To eliminate all pollution is probably impossible and it certainly would be prohibitively expensive. A balancing of the costs and benefits of various aspects of environmental quality control is necessary. No less necessary is the careful evaluation of the incidence of those costs and benefits.

2.1.5 Decision-Making Under Uncertainty

Clouds of ignorance and uncertainty surround the problem of environmental deterioration. The subtle chemical, physiological and ecological effects of some kinds of pollution become evident only after extended periods of time. Controversies may rage about the validity of deleterious effects and their causes. Meanwhile, the process of environmental degradation continues. The point of irreversibility may be reached before ignorance and uncertainty is dissipated. From this two points follow:

(1) Programs to increase our understanding of environmental decay and its effects should have a place in a control program.

(2) It is necessary to explicitly confront the problem of decision-making under uncertainty, and to incorporate decision strategies into the environmental quality control framework.

2.1.6 The Development of Public Perception

The public was long unaware and unconcerned about the real and threatened deterioration of the environment. This is changing rapidly. The mass media have seized the issue and are mobilizing public concern.

It is important to understand how public perceptions of environmental deterioration form and how they are translated into pressures for pollution control and into political issues.

2.1.7 The Many Facets of the Pollution Problem

We have noted some aspects of the pollution problem; the economic and the perceptual. These are only two of the many facets of this complex set of problems.

Pollution is also a medical problem; certain kinds of pollution cause diseases in the human body.

It is an ecological problem: as wastes enter the ecological cycle, the balance is upset and altered. The resulting changes harm many species of life, including man.

Pollution is a scientific problem; one of defining and understanding the various types of pollutants and pollution processes.

It is a technological problem; one of devising less costly methods of dealing with pollution, of designing better ways of lowering the waste output of industrial processes, and of finding more efficient and thorough means of waste disposal.

Pollution is a political problem. Many actors play roles in the dismal drama of environmental degradation. Individual citizens, industries and governments each have their own objectives and powers to impede or further programs of environmental quality control. Canadian constitutional ambiguities about provincial and federal powers complicate the scene.

Pollution is an administrative problem, one of organizing scientific and medical research, of choosing appropriate policy goals, of assigning these goals suitable priorities in the over-all scheme of public objectives, and of selecting the correct strategies to achieve them.

The problem is further complicated because these various elements of the problem overlap and interact. Uncertainty and ignorance becloud the issue; the present lack of adequate accurate and accessible data perpetuates our lack of knowledge about the kind and extent of pollution while uncertainty about future developments complicates the decision-making process.

The development of a Federal strategy, to control the quality of our environment should take full cognizance of the complex system to be controlled. A systems analytic approach seems mandatory. This document attempts to outline such an approach.

2.2 Objectives of the Proposed Study

The objectives of the study are to develop a Federal Strategy for Environmental Quality Control as detailed by the Department of Energy, Mines and Resources on April 1, 1969. Those objectives were set forth in the following words:

> A "strategy", or conceptual framework, is needed to assist governments to evaluate new policies and programs being developed to deal with problems of pollution, urbanization and the quality of life. This "strategy" must cover the full spectrum of the environmental problem including the perception of pollution, the measurement and effects of varying quality levels, the evaluation of benefits and disbenefits, the appropriate incentives to reduce present pollution and to prevent future pollution, the institutional arrangements to obtain effective environmental quality management by the three levels of government, the economic "system" which internalizes the externalities and the appropriate types of controls locally, regionally, and nationally. The problem appears complex, but its clarification may reveal simple, direct steps and an obvious priority ranking.
>
> In summary, the Department of Energy, Mines and Resources of the federal government is seeking advice on a total approach to the problem of environmental pollution - an approach that is responsive to public preference, that is economically and technologically sound and also administratively feasible.

To effectively meet the problem, a Federal Strategy for Environmental Quality Control should possess certain attributes. The following list suggests some of those attributes.

(1) It must be efficient in that it must be designed to achieve the most desirable environmental quality control results from public and private investment in the process.

(2) It must incorporate the best available information, scientific knowledge, technical capability, political and legal acumen, economic analysis and managerial design.

(3) It must be an integrated strategy that recognizes the complex interactions of biochemical, hydrologic, ecologic, health, aesthetic, economic, political and legal factors. The strategy must be based on a sophisticated systems analysis of all these factors.

(4) It must be an adaptive strategy that recognizes present ignorance and uncertainties, provides for problem-oriented research and data collection, and looks to incorporate these as well as the lessons of experience into modifications of policy.

(5) It must convincingly display Federal concern for the problem and energetic action action to cope with it.

(6) It must realistically take account of the interests and objectives of other political, economic and social groups; it must seek to mold those local interests and objectives so as to achieve the overall objectives.

(7) It must help the Federal Government to identify and aid proposed local measures that are consistent with overall Federal policy and to identify and resist pressures to aid proposed local measures that are not consistent with that Federal policy.

(8) It must be realistic in terms of the resources which are likely to be available to the Federal, provincial and municipal governments and to industry for investment in environmental quality control programs.

It is the objective of this proposed study to develop a Federal Strategy for Environmental Quality Control with those attributes.

2.3 The Approach to the Problem

Three main attributes characterize our approach to the problem of developing a Federal Strategy for Environmental Quality Control. They are as follows:

(1) Policy orientation of the study.

(2) Systems analysis methodology

(3) Multi-disciplinary team of participants.

2.3.1 Policy Orientation

The objective of this study is to produce information that will assist governments in evaluating new and old policies and programs. Practical guides to governmental decision-making and action must flow from the study's results.

This policy orientation has several implications. First, the study team must keep its attention focused on the practical purpose of the study. The study should effectively marshall and integrate the best of existing knowledge.
Second, the study team must include members with strong ability, interest and experience in policy formulation. Third, the study team must build and maintain close liaison with the various public and private groups with strong interests and responsibilities in the area of pollution control.

2.3.2 Systems Analysis Methodology

The problem of environmental quality control is multifaceted. The system to be controlled and the controlling system comprise many subsystems linked by complex interdependencies and feedback relationships. As we perceive them, the main subsystems are as follows:

- the physical subsystem
- the economic subsystem
- the demographic subsystem
- the health subsystem
- the socio-political subsystem
- the governmental institutional-administrative subsystem
- the technical subsystem

The complexity of the interactions among the various parts of the system compels a systems analytic approach to the problem of environmental quality management. Systems analysis is the antithesis of partial or piecemeal analysis. It strives to take account of

interactions and interdependencies among subsystems of larger systems.

A systems analytic approach to policy formulation proceeds by ascertaining objectives, determining constraints, elaborating alternative policies and estimating the magnitudes and incidences of the costs, benefits and risks of the feasible alternatives. It explicitly provides for ex post evaluation of policy and for adaptive improvement as more feedback and other information become available.

2.3.3 Multi-disciplinary team

A multi-disciplinary team of experts from various specialties is needed to accomplish a systems analytic policy development study for environmental quality control. The team which we propose consists of participants from the following disciplines:

Architecture and Urban Planning
Biology
Ecology
Economics
Economic geography
Law (including Constitutional Law)
Engineering
Operations Research
Political Science (including Public Administration)
Public Health

Representatives from other disciplines may be added to the group if their talents are needed.

2.4 General Plan of the Study

The study plan comprises a number of separate studies to be undertaken by various specialists. These individual studies will be integrated and coordinated by members of the study group specifically charged with that responsibility. Additionally, the entire study group will meet periodically in workshop seminars for the purpose of critical evaluation, coordination of work, and cross-fertilization of ideas.

The next section consists of a preliminary outline of the final report. Following that is a brief description of the individual studies that are now planned. Finally, a preliminary schedule of the entire project is presented.

2.4.1 A Preliminary Outline of the Report

Planning of the study has proceeded by formulating the kind of final report that we intend to submit. This section contains a preliminary and general outline of that report as we now envisage it. The outline will obviously undergo revision as the study proceeds.

A PRELIMINARY OUTLINE

1. SUMMARY OF CONCLUSIONS AND RECOMMENDATIONS

2. INTRODUCTION

2.1 STATEMENT OF THE PROBLEM

2.1.1 Public concern in Canada

2.1.2 Public concern elsewhere

2.1.3 What is pollution?

2.1.4 Market failure

2.1.4.1 Externality problem

2.1.4.2 Public goods and public bads

2.1.4.3 Difficulties of enforcing exclusion principle of ownership

2.1.4.4 Imperfect certainty

2.1.5 Public action required for attainment of social optima

2.1.6 Facets of the problem

- scientific
- medical
- public perception and attitudes shaping

government policy
- economic
- technical
- administrative

2.1.7 Further complications:
- interaction of elements
- multi unit control system

2.1.8 Need for a systems analysis approach to environmental quality management

2.2 DESIGN FOR SYSTEMS CONTROL STRATEGY

2.2.1 Conceptualization of a control strategy

2.2.2 Elements of a control strategy

2.2.2.1 Monitoring

2.2.2.2 Formulation of objectives

2.2.2.3 Alternative instruments

2.2.2.4 Synthesis of objectives and alternatives: cost/benefit analysis

2.2.2.5 Methods of criteria or choice

2.2.2.6 Feedback and evaluation of control

2.2.3 Complications of applying a systems approach to environmental quality management

2.2.3.1 Uncertainty and ignorance

2.2.3.2 Non hierarchical system:

several levels of government

- international
- federal
- provincial
- municipal
- regional authorities,

3. SYSTEM TO BE CONTROLLED

3.1 DESCRIPTION OF THE PROCESSES OF POLLUTION

3.1.1 A description of the pollution cycle

3.1.2 General definitions of pollution

3.1.3 Identification and description (in physical terms) of the various specific types of pollutants.

3.1.4 Description of the pollution processes

3.1.5 The interactions of the pollutants

3.1.6 The influence of geographical factors

3.1.7 Discussion on urban pollution.

3.2 EFFECTS OF POLLUTION

3.2.1 Effects on human health

3.2.2 Effects on plant and animal life

3.2.3 Complex physical effects e.g. eutrophication

3.2.4 Economic effects

3.2.5 Aesthetic effects

3.2.6 Effects on the ecological cycle

3.3 EXTENT OF POLLUTION

3.3.1 The measurement of pollution levels

3.3.2 Objects for measurement

- the quantity and quality of emissions
- concentration of pollutants
- the effects of pollution

3.3.3 Appropriate units of measurement

3.3.4 Specific data (physical) on existing pollution levels

3.3.5 Catalogue of pollution problems

3.3.6 General assessment of existing pollution problems

3.3.7 Past trends of levels

3.3.8 Future forecasts of pollution levels under alternative assumptions.

4. THE ECONOMICS OF POLLUTION

4.1 ECONOMIC THEORY AND POLLUTION

4.1.1 The opportunity costs of pollution

- 4.1.1.1 The conflict between environmental quality and economic growth objectives.
- 4.1.1.2 Benefit functions associated with the reduction of pollution and attendant costs.
- 4.1.1.3 Conceptual problems of measuring pollution costs

4.1.2 The incidence of pollution costs

4.1.3 The Polluters and the Pollutees

- 4.1.3.1 Efficient allocation of pollution activity for socially acceptable levels.
- 4.1.3.2 The relationship between environmental quality and control and location patterns.

4.1.4 Market Failure

- 4.1.4.1 Exposition of the externality problem
- 4.1.4.2 The problem of public goods
- 4.1.4.3 Lack of clearly defined property rights
- 4.1.4.4 The economies of scale and pollution control
- 4.1.4.5 Inadequate concern for the future
- 4.1.4.6 Imperfect knowledge
- ✓ 4.1.4.7 The concentration of economic power

4.2 THE EMPIRICS OF POLLUTION

(Quantification, Measurement and Case Studies).

4.2.1 The costs of pollution

4.2.1.1 Estimating the costs of pollution for several different pollution levels

4.2.1.2 Regional impact

4.2.1.3. The tangible costs

4.2.1.3.1 Loss in income through illness and death

4.2.1.3.2 Extra health care costs

4.2.1.3.3 Reduction of property values

4.2.1.3.4 Costlier industrial processes

4.2.1.3.5 Water purification

4.2.1.3.6 Food processing and decontamination

4.2.1.3.7 Population relocation

4.2.1.3.8 More and costlier holidays and recreation

4.2.1.3.9 Creating amenable micro environments

4.2.1.3.10 Air filtering and conditioning

4.2.1.3.11 Extra painting and cleaning (streets, homes, buildings)

4.2.1.3.12 Sound deadening (tiles, carpets, etc.)

4.2.1.3.13 Extra laundry and drycleaning

4.2.1.4 The intangible costs associated with pollution, i.e loss of psychic income

- through fear of illness
- aesthetic displeasure

4.2.1.5 Derivation of benefit functions

4.2.2 The incidence of pollution costs

4.2.2.1 The identification of the groups bearing pollution costs. Estimating the extent of their burden

4.2.2.2 Assessing the incidence of costs and benefits of pollution control

4.2.3 The Polluters

4.2.3.1 Identification of heavy polluters and the extent of their polluting activities

4.2.3.2 An examination of the various industries' response to different alternatives of pollution control. A model of industry response to alternative policy instruments may be developed for use here.

5. ATTITUDES, INSTITUTIONS AND POLLUTION

5.1 THE PERCEPTION OF POLLUTION

5.1.1 The assessment of public perception of pollution

5.1.2 Sources of information on pollution

- direct observation via the five senses
- hearsay
- newspapers
- radio
- television
- publicity of special interest groups
- commissions
- government bodies

5.1.3 The biases of the sources

5.1.4 The evolution of public attitudes to pollution and pollution Control

5.1.4.1 Are there thresholds of pollution tolerance?

5.1.4.2 Indicators of willingness to pay for environmental quality

5.1.4.3 Attitudes on financial responsibility of pollution control

5.1.4.4 Attitudes toward alternative pollution control policies

5.2 INTEREST GROUPS AND POLLUTION

5.2.1 The identification of interest groups

5.2.2 The goals and objectives of interest groups

5.2.3 The influence and powers of interest groups

5.3 GOVERNMENTS AND AGENCIES

5.3.1 Identification and description of governmental and intergovernmental bodies and agencies with relevant decision-making powers

5.3.2 The objectives of government bodies and agencies and the implications for environmental control policies

5.3.3. The extent of their jurisdictional powers

5.3.4 Possible areas of cooperation, competition, duplication and interference

5.4 LEGAL ASPECTS

5.4.1 Constitutional problems of environmental control

5.4.1.1 The allocation of powers between the various levels of government in Canada

5.4.1.2 Constitutional ambiguities

5.4.1.3 Possible judicial interpretations of constitutional ambiguities

5.4.1.4 Implications for policy

5.4.2 Catalogue and evaluation of federal and provincial laws dealing with pollution matters

5.4.3 A summary of relevant municipal by-laws

5.4.4 Laws regarding the establishment of regional authorities

5.4.5 The potential within existing legislation to increase the effectiveness of federal programs of environmental control

✓ 5.4.6 International laws, treaties and organizations germane to environmental quality control

5.4.6.1 Past and present Canadian participation

5.4.6.2 Effectiveness

5.4.6.3 Implications for policy

5.5 THE OBJECTIVES OF POLLUTION CONTROL

5.5.1 The links between public attitudes and government decisions, the integration of public opinion in the formulation environmental control objectives

5.5.2 A synthesis of the information relevant to the formulation of objectives in sections 3, 4 and 5

5.5.3 Alternative explicit objectives for possible adoption by the federal government

6. THE TECHNOLOGY OF POLLUTION CONTROL

6.1 THE TECHNOLOGY OF POLLUTION MONITORING

6.2 THE TECHNOLOGY OF POLLUTION PREVENTION

6.3 THE TECHNOLOGY OF POLLUTION ABATEMENT

Each technology to be examined in the following terms:

6 x 1 description of the technology

6 x 2 evaluation of the technology

- effectiveness
- costs of use
- trends in the development of the technology
- experience elsewhere: American and European

6 x 3 the extent and type of research and development

6 x 4 the organization of research and development activities

6 x 5 assessment of the organizational framework of research and development

6 x 6 potential benefits of existing and potential research and development programs.

7. ANALYSIS OF ALTERNATIVES: THE INSTRUMENTS OF POLLUTION CONTROL

7.1 PUBLIC INFORMATION AND EDUCATION

7.2 MORAL SUASION

7.3 INSTITUTIONAL REARRANGEMENTS, to internalize the externalities (The establishment of appropriate regional authorities, eg. water management agencies, Professor Dales' proposal)

7.4 INTERNATIONAL ARRANGEMENTS, AGREEMENTS AND INSTITUTIONS

7.5 MONITORING POLLUTION

7.6 ESTABLISHING STANDARDS

7.7 ENFORCING STANDARDS BY ADMINISTRATIVE REGULATION

7.8 RESEARCH AND DEVELOPMENT

7.9 THE INCLUSION OF NON-POLLUTION CLAUSES IN GOVERNMENT CONTRACTS (Federal and Provincial)

7.10 CONTROL OF CROWN CORPORATIONS AND FEDERAL ENTITIES

7.11 RECOURSE TO OMBUDSMEN

7.12 ECONOMIC AND DEMOGRAPHIC PLANNING (Zoning, Regional Development and Locational Policy)

7.13 DIRECT SUBSIDIES e.g. forgiveable loans for both pollution prevention and abatement

7.14 INDIRECT SUBSIDIES e.g. depreciation allowances

7.15 TAXES, PRICES, EMISSION CHARGES FOR POLLUTION

7.16 DIRECT INVESTMENT IN POLLUTION PREVENTION AND ABATEMENT FACILITIES

each"instrument"to be examined in the following terms:

7 x 1 description of current use of the instrument

7 x 2 survey of Canadian experience

7 x 3 survey of foreign experience

7 x 4 the effectiveness of the instrument in terms of controlling

pollution - in physical terms at each level of operation

7.x.5 effectiveness in encouraging recycling

7.x.6 spillover effects

7.x.7 response to the instrument, effects of the extent and timing of expenditures

7.x.8 effect on industrial location decisions

7.x.9 ease of evasion

7.x.10 administrative and enforcement costs

7.x.11 effect on government budgets

7.x.12 effect on the profitability of operations for polluters

7.x.13 resulting price adjustments and shifting of costs

7.x.14 effectiveness of the instrument under conditions of uncertainty

7.x.15 flexibility

7.x.16 possible institutional arrangements for implementation

7.x.17 legal, political, jurisdictional and constitutional implications

7.x.18 public opinion and perception

7.x.19 possible bottlenecks in terms of scarce inputs; materials and manpower.

8. SYNTHESIS OF VARIOUS BLENDS OF CONTROL INSTRUMENTS

An environmental control strategy should be a synthesis of policy instruments. Several packages of instruments (policy alternatives) will be considered according to the following criteria:

8 .x .1 physical and ecological effectiveness
8 .x .2 an evaluation of anticipated benefits and their incidence
8. x 3 an evaluation of anticipated costs and their incidence
8. x. 4 effect on industrial location and relocation patterns
8. x .5 the time path of implementation
8. x .6 the time path of effects for both costs and benefits
8. x .7 effectiveness under conditions of uncertainty and imperfect information
8. x .8 discussion of the transitional stage towards administrative implementation
8. x .9 effectiveness and flexibility in a dynamic evolving situation
8. x .10 administrative practility
8. x .11 the legal, political and jurisdictional aspects
8. x .12 interest group reactions
8 .x .13 public opinion and perception
8. x .14 list of the constraints emerging from the evaluation

9. RECOMMENDATIONS

9.1 FOR EACH OF SEVERAL POSSIBLE LEVELS OF FUNDING, THE MOST EFFECTIVE SET OF POLICY INSTRUMENTS

9.1.x.1 description of policy instruments

9.1.x.2 time phasing and priority ranking of individual instruments

9.1.x.3 multi-period flow of funds

9.1.x.4 benefits anticipated and their time pattern

9.1.x.5 administrative implications

9.1.x.6 political support and opposition anticipated

9.1.x.7 public opinion and perception, interest group reaction

9.1.x.8 criteria for evaluating the effectiveness of the strategy in operation

9.2 FOR EACH OF SEVERAL LEVELS OF ENVIRONMENTAL CONTROL, THE BEST SET OF INSTRUMENTS

9.2.x.1 description of instruments

9.2.x.2 time phasing and priority ranking of individual instruments

9.2.x.3 multi period flow of funds

9.2.x.4 benefits anticipated and their time patterns

9.2.x.5 administrative implications

9.2.x.6 political support and opposition anticipated

9.2.x.7 public opinion and perception, interest group reaction

9.2.x.8 criteria for evaluating the effectiveness of the strategy in operation

2.4.2 Specific Studies to be Undertaken

Twenty-three studies tentatively have been scheduled to cover the topics listed in the outline. This list of studies is only preliminary because the outline is expected to undergo revision.

TENTATIVE LIST OF STUDIES

1. General description of pollution cycles. Definitions of pollution.
2. Air pollution and technology.
3. Water pollution and technology.
4. Soil pollution and technology.
5. Urban pollution.
6. Pollution and its effects on the ecological cycle.
7. Pollution affecting man's aesthetic pleasure in his environment.
8. The effects of pollution on plant life.
9. The effects of pollution on animal life.
10. The effects of pollution on human health.
11. Economic theory and pollution.
12. The costs of pollution (empirics).
13. The incidence of pollution costs (empirics).
14. Polluters and pollutees (empirics).
    - inter and intra industry comparisons
    - model of industry reaction

- publicity of special interest groups
- commissions
- government bodies

15.3 Biases of the Sources

15.4 The evolution of public attitudes to pollution and pollution control

15.4.1 The thresholds of pollution tolerance

15.4.2 The willingness to pay for environmental quality

15.4.3 Attitudes and financial responsibility of pollution control

15.4.4 Attitudes towards alternative pollution control policies

- possible methodologies
  - (a) questionnaires
  - (b) position paper
  - (c) various interviews

16. Interest Groups and Pollution

16.1 The identification of interest groups

16.2 The goals and objectives of interest groups

16.3 The influence and powers of interest groups

16.4 Areas of conflicting interest

17. Governments and Agencies

17.1 Identification and Description of Governmental and Inter-Governmental Bodies and Agencies with Relevant Decision-Making Powers

17.2 The objectives of government bodies and agencies and the implications for environmental control policies

17.3 The extent of the jurisdictional powers

17.4 Possible areas of overlapping, competition, duplication and

15. The preception of pollution.
16. Interest groups and pollution.
17. Governments and agencies.
18. Legal Aspects.
19. Objectives of pollution control - the role of perception in objective formulation.
20. Synthesis of relevant information for objective formulation. (based on studies 1 - 19).
21. Explicit objectives.
22. Analysis of alternatives: the instruments of pollution control.
23. Synthesis of various blends of control instruments; strategies.

2.4.2.1 The System to be Controlled

The objective of studies #1 - 10 is very concisely to summarize the physical aspects of environmental degradation. Subsections will concern the major categories of pollution; e.g., air, soil, water (including rivers, ground water, lakes, and oceans), and auditory and visual pollution to the extent that project resources permit.

Each type of pollution will be presented in four main categories:

(1) The physical process of pollution: description, interactions of various pollutants, outside influences, units of measurement.

(2) The effects of pollution: on natural resources, on plant and animal life, on human health and on the ecological balance.

(3) The extent of pollution: measurement of existing levels, forecasts, identification of major problems.

(4) The technology of pollution control: monitoring, prevention and abatement. A description and evaluation of these technologies, and relevant research and development activities.

Another study, entitled "Initial Study of the Divisions of Environmental Pollution in Canada" is currently in progress in the consulting firm of Hedlin, Menzies and Associates Ltd. The Department of Energy, Mines and Resources expects Hedlin, Menzies to provide data on the level and extent of environmental pollution and the costs of pollution control measures. Thus we expect a substantial input in this section as well as the next: "The Economics of Pollution"

2.4.2.2 The Economics of Pollution

The economic study has been broken into theoretical #11, and empirical #12 - 14 components.

2.4.2.2.1 Economic Theory and Pollution

The purposes of this section are (1) to explore the conceptual difficulties involved in identifying and measuring the costs and benefits of pollution and pollution control, (2) to understand the incidence of pollution costs as they are borne by groups in society, (3) to understand the relationships between pollution control costs and the costs of production, and (4) to explore the problems of market failure and internalizing externalities. A benefit function would be developed for the

purpose of evaluating the magnitude and incidence of benefits derived from evironmental improvement. We intend also to explore the conceptual problems of developing a "demand function" for environmental improvement which would reflect both costs and income elasticities of demand for this "product".

2.4.2.2.2 The Empirics of Pollution Economics.

Ideally, this section should seek: (1) to empirically measure the magnitude and incidence of pollution costs. (2) to empirically assess the probable impacts of various pollution control measures on the cost functions of polluters, and (3) to empirically estimate the benefit functions and/or demand functions described above.

2.4.2.3 The Perception of Pollution

The objectives of this part of the study (#15) are (1) to understand how people in various parts of Canada perceive pollution problems, (2) to understand what factors condition public awareness of this problem, (3) to understand how public perception of environmental degradation is changing over time and (4) how this perception translates itself into political pressure and/or political discontent. We seek (5) to understand how government can enlist the public concern in its effort to control pollution, and (6) to understand what people in various parts of the country think that

government agencies should do about pollution. Finally, (7) we hope to learn something about the costs that citizens would be willing to incur in order to achieve various quality levels.

2.4.2.4 Interest Groups and Pollution

The purposes of this study (#16) are (1) to identify the various interest groups which stand to gain or lose from various levels of environmental quality control, (2) to understand the goals and objectives of these interest groups, their influence and powers and the extent to which their energies may be enlisted in support of the program of environmental quality control. Where opposition can be anticipated, we seek (3) to understand how that opposition can be surmounted.

2.4.2.5 Governments and Agencies

The purposes of this section (Study #17) are (1) to identify the various government and intergovernment bodies and agencies that have decision-making powers and responsibilities in the area of environmental quality control, (2) to understand the operational objectives of these bodies and agencies and their implication for environmental control policies. We shall examine the extent of jurisdictional powers and explore possible areas of cooperation, competition, duplication and interference.

2.4.2.6 Legal Aspects

The purpose of this part of the study (#18) will be to explore the legal aspects as they affect a program of environmental quality control. The constitutional difficulties and their implications for policy will be studied. We will examine the relevant federal and provincial laws dealing with pollution, municipal by-laws, laws regarding the establishment of regional authorities, and various international laws, treaties and organizations which are germane to environmental quality control policy.

2.4.2.7 Analysis of Alternative Instruments of Pollution Control

This is a major part of the entire study. The purpose of this study (#22 - 24) is to examine and evaluate all of the feasible instruments within reach of the federal government which might be included in a strategy for environmental quality control. An indication of the range of alternatives which we presently plan to examine may be gleaned from section 7 of the preliminary outline of the final report. Each of the various instruments will be examined and evaluated. Among the aspects of each alternative instrument to be studied are the following: (1) Canadian and foreign experience in the use of the instrument (2) the effectiveness of the instrument, (3) the administrative and enforcement feasibility and cost, (4) the legal and jurisdictional implications of the instruments used, (5) the effect on government expenditures, and (6) probable

public perception and reaction.

2.4.3 Integration of Studies and Development of Strategy Recommendations

In a study of this magnitude with so many interlocking parts, it is mandatory that each piece be accomplished on schedule and integrated properly into the overall study. In addition, it is obvious that the quality of the policy recommendations will depend crucially on the distillation of important information from the constituent studies.

To achieve these aims, we have tentatively scheduled a number of seminars, to be attended by project participants. The objectives of these seminars are:

(1) To review the progress of the studies
(2) To provide an opportunity for discussion and exchange of ideas.
(3) To provide a vehicle for the development of strategies.

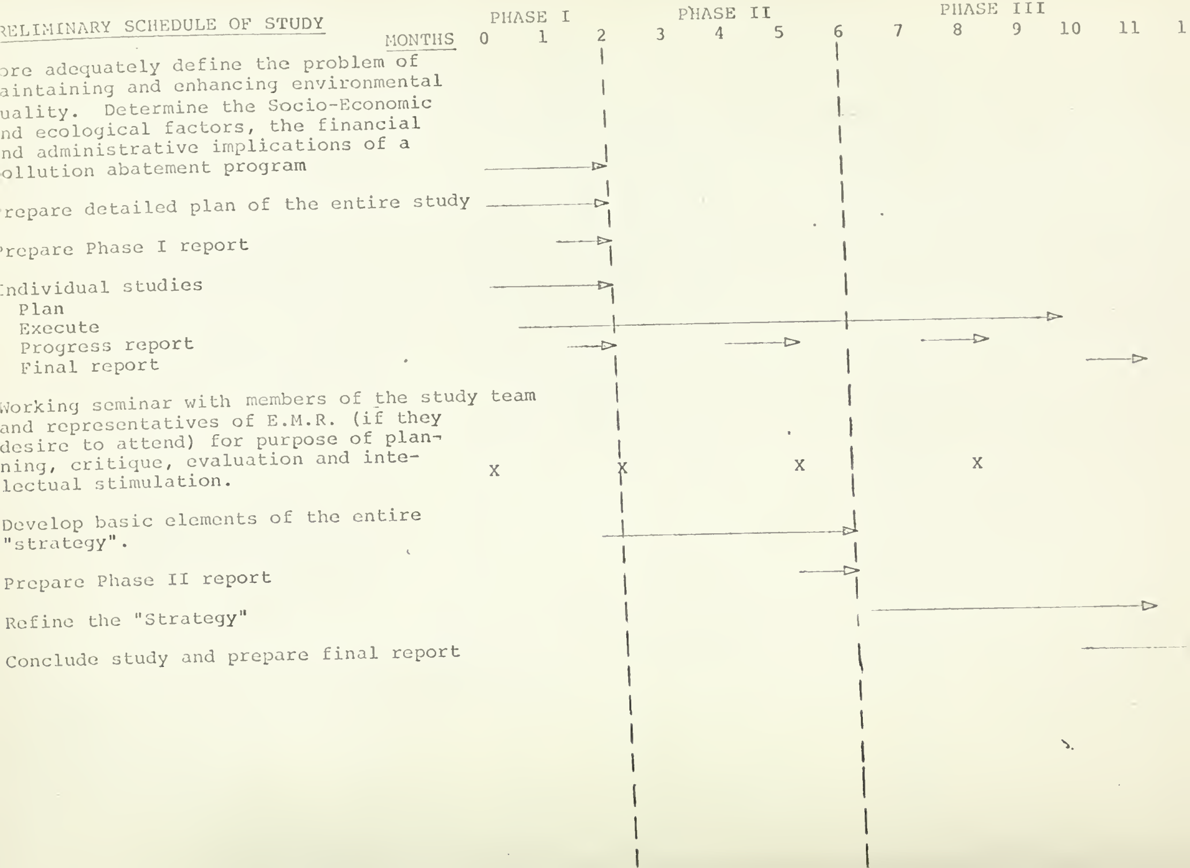
2.4.4 Preliminary Schedule of Study

To meet the timing requirements of the Department of Energy, Mines and Resources, the study has been divided into three phases, of 2 months, 4 months and 6 months duration respectively.

Figure 1 displays our preliminary and gross schedule of the study.

IGURE 1

RELIMINARY SCHEDULE OF STUDY



ore adequately define the problem of aintaining and enhancing environmental uality. Determine the Socio-Economic nd ecological factors, the financial nd administrative implications of a ollution abatement program

repare detailed plan of the entire study

repare Phase I report

ndividual studies
- Plan
- Execute
- Progress report
- Final report

Working seminar with members of the study team and representatives of E.M.R. (if they desire to attend) for purpose of planning, critique, evaluation and intelectual stimulation.

Develop basic elements of the entire "strategy".

Prepare Phase II report

Refine the "Strategy"

Conclude study and prepare final report

Internal progress reports of all parts of the study will be made at the end of months 2,5,8 and 11. Workshops or seminars of all participants of the study team will be held at the beginning of the project and at the end of months 2,5, 8 and 12.

Written and oral reports will be submitted to E.M.R. at the end of months 2 and 6. The final report will be submitted at the end of month 12 at which time a final seminar will be held.

3. Personnel

Professional personnel for this project will be drawn from the Systems Research Group, Resources for the Future Inc., Laval University, The University of Manitoba, and the University of Toronto. A number of senior undergraduate and graduate students will augment the study team: these will be working under the direction of the specialists in their fields. Facilities and support personnel will be supplied by the Systems Research Group.

The following are the key personnel on the proposed project and the roles to be played by each:

3.1 Blair T. Bower

Acting Director, Quality of Environment Program, Resources for the Future Incorporated, Washington, D.C. Role: Consultant on environmental problems and liaison with other RFF personnel who will act as resource people for the project as required.

3.2 J.R. Brown

Professor and Chairman, Department of Physiological Hygiene, University of Toronto. Role: Project Specialist on pollution and public health.

3.3 Ian Burton

Associate Professor, Department of Geography, University of Toronto. Role: Project Specialist on perception of pollution problems.

3.4 Steven I. Centner

Economist and Senior Systems Analyst, Systems Research Group. Role: Economic Analyst and designer of mathematical models.

3.5 Donald A. Chant

Professor and Chairman of the Department of Zoology, University of Toronto. Role: Project Specialist on ecological aspects of environmental degradation.

3.6 John H. Dales

Professor of Economics, University of Toronto. Role: Project Specialist on economic aspects of pollution control - especially concerning problems of internalizing external economies and designing effective ownership and institutional arrangements.

3.7 Yves Dube

Professor of Economics and Dean of the Faculty of Social Science, Laval University, Quebec. Role: Project Specialist on economic policy and regional economics.

3.8 J. Stefan Dupre

Professor of Political Science and Director of the Center for Urban and Community Studies, University of Toronto. Role: Project Specialist on urban problems, intergovernmental relations and public administration.

3.9 Dale Gibson

Professor of Law, University of Manitoba. Role: Project Specialist on Canadian Constitutional Law and its implications for pollution control policy.

3.10 Gerhard W. Heinke

Assistant Professor, Department of Civil Engineering, University of Toronto. Role: Project Specialist on problems of water pollution, eutrophication, and the technology of pollution control.

3.11 Richard W. Judy

Professor of Economics and Computer Science, University of Toronto. Principal, Systems Research Group, Toronto. Role: Project Director. Plans, schedules, coordinates, evaluates and integrates project work.

3.12 Elizabeth E. Lake

Economist, Systems Research Group. Role: Assists the Project Director in the planning, scheduling, coordination and integration of project work.

3.13 Jack B. Levine

Principal, Systems Research Group. Role: Assists the Project Director in developing and evaluating policy alternatives, designs and applies simulation models for policy evaluation.

3.14 Joseph L. Sweeney

Systems Analyst and Urban Planner, Systems Research Group. Role: Project Specialist on the urban environment and developer of computer simulation models.

3.15 George Weathersby

Economist, Systems Research Group. Role: Specialist on decision theoretic aspects of problem formulation and control systems design.